

Proposed Water Quality Surveillance Network Using Physical, Chemical and Biological Early Warning Systems (BEWS)

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The Homeland Protection Act of 2002 specifically calls for the investigation and use of Early Warning Systems (EWS) for water security reasons. The EWS is a screening tool for detecting changes in source water and distribution system water quality. A suite of time-relevant biological and physical/chemical water quality monitors applied in an EWS can provide timely information to aid decision-makers in the management and protection of the nation's water resources and measure the success of water quality control programs implemented under the Clean Water Act. A suite of monitors is necessary because no single organism will be sensitive to all contaminants at relevant concentrations. Current biological water quality monitors use fish, bivalves, arthropods, and bacteria and are capable of detecting contaminants at relatively short time periods (hours). Strategic placement of water quality monitors at both source water and distribution system locations of high vulnerability, likely targets, and control points may detect the presence of unsuspected chemicals or toxic interactions occurring as a result of spills, legal or illegal discharges, or intentional introductions. This work couples the "Canary in the coal mine" approach with the latest in behavioral, physiological, and physical/chemical monitoring techniques and current computing and communications equipment, to provide time-relevant data over a range of spatial scales (e.g., watersheds or regions). Because responses are sometimes caused by variations in water quality parameters (e.g., temperature, dissolved oxygen, or conductivity), selected physical and chemical parameters should be monitored simultaneously to facilitate interpretation of EWS data.

Many organizations in Europe currently use biomonitoring (BEWS) to monitor water supplies. The Molecular Ecology Research Branch (NERL) and the Water Quality Management Branch (NRMRL) propose to go beyond the European approach by investigating the use of a combination of advanced technologies that are time-relevant whole organism and molecular biosensing methods. Ultimately, we envision setting up a continuous, time-relevant national water quality surveillance network in all major rivers in the U.S. that are used for water supplies and their distributions systems. We plan to test the approach using Cincinnati, OH, as a model, with an EWS in the source water, Ohio River, and within the City's drinking water distribution system. Complimenting these whole organism systems will be molecular measures on fish and invertebrates using near-Real-time PCR methods for measuring--gene expression and microarray technologies. A model data collection, storage, and analysis infrastructure will be created to collate and analyze data from the EWS for detection and tracking of water quality events.

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